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heart of echinoderms. His study of *Asterias hyadesi*, a new star-fish from Cape Horn, has led him to conclusions identical with those arrived at from the study of Comatula. The "heart" in Comatula is but a glandular organ, the point of departure of the reproductive organs, and there are no true vessels, only irrigation canals in which sea-water always runs. Part of the water which enters by the madreporic plate of Asterias passes into the subambulacral cavities, the schizocele, and the genital cavity. Sea-water plays the part of blood not only in echinoderms, but in all zoöphytes, which M. Perrier believes ought to form a sub-kingdom, as arranged by De Blainville.

Vermes, etc.—W. Bateson (*Quart. Jour. Mic. Sci.*, 1886,) gives a continued account of the later stages in the development of *Balanoglossus kowalevskii*, and of the morphology of the Enteropneusta. This is followed by an article upon the ancestry of the Chordata in which he endeavors to clear away the difficulty interposed by the unsegmented condition of the Enteropneusta to their right to a place among the vertebrate ancestry. He holds that repetition of organs and sets of organs is of common occurrence among animals, but that, however far back a segmented ancestor of a segmented descendant may possibly be found, yet ultimately the form has to be sought for in which these repetitions had their origin.——The Bolletino of the Adriatic Natural History Society contains a list of the fauna of the Adriatic by Michele Stossich. The Cœlenterates are included in Vol. IX, No. 1, 1885.——M. Stossich (Boll. d. Soc. Adri. d. Sci. Nat. 1885) gives an account of various species of Distomum and allied genera found in the intestines of fishes in the neighborhood of Trieste.

EMBRYOLOGY.[1]

THE DEVELOPMENT OF THE MUD-MINNOW.—The ova of *Umbra limi* measure 1.6^{mm} in diameter and are laid singly upon aquatic plants to which they adhere for a time by means of a thin coating of adhesive matter which invests them. The vitellus and blastodisk is moderately clear and yellowish in color. Just underneath the blastodisk there is a rounded, flattened cluster of highly refringent oil-drops of small size. As the blastodisk spreads these oil-drops become more and more diffused or scattered over the vitellus just beneath the blastoderm.

At the time of the formation of the blastodisk, the vitellus displays a most active amœboid activity of its substance. This is so active that the outline of the vitellus changes very distinctly at intervals of a few seconds. In fact, I know of no teleostean egg which has been hitherto described in which such amœboid movements of the vitellus are so pronounced and rapid.

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[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

The young mud-minnow leaves the egg on the sixth day, at which time it measures 5^{mm} in length. A bilaterally symmetrical net-work of blood-vessels is developed beneath the outer sac covering the vitellus, the blood-channels being excavated in the periblastic and cellular splanchnopleural covering of the latter. The oil-drops soon rearrange themselves on the anterior, lateral and ventral aspects of the vitellus. Three days after hatching the air-bladder becomes apparent as a fusiform vesicle behind the pectorals and above the foregut, when the young fish is viewed as a transparent object.

Pigment is rapidly developed upon the upper and lateral aspects of the body, and by the sixteenth day the larvæ have become pretty dark in color, when observed from above.

Immediately after hatching it is observed that there is a small projecting lobe at the end of the tail. Into this lobe the notochord extends. This terminal lobe of the tail is much narrower than the portion of the caudal lobe just in advance of it. As development proceeds it also becomes longer and more conspicuous. This terminal lobe of the tail of the larval mud-minnow is clearly homologous with the *opisthure* of the larval Lepidosteus and the adult *Chimæra monstrosa.* It is certain that it is subsequently absorbed, since the more advanced stages prove that the rays of the permanent caudal fin are developed far in advance of the opisthural lobe above described.

There is a slight tendency to form an opisthural lobe in the larva of the pike, but the larva of none of the teleostean forms hitherto studied approach the Rhomboganoids so closely in respect to the manner in which the tail is developed as Umbra.—*John A. Ryder.*

THE DEVELOPMENT OF FUNDULUS HETEROCLITUS.—The embryology of this oviparous cyprinodont fish differs very considerably from that of the viviparous types, such as Gambusia and Anableps. Features which are especially noteworthy are the presence of a well-developed zona radiata, which is thickly covered with very fine filaments, such as are found on the eggs of *Belone longirostris,* but much finer. The writer is not aware that any such filaments have hitherto been detected on the eggs of any Cyprinodont. As in the cases of Belone, Exocœtus, Menidia, etc., these filaments intertwine with those of adjacent eggs, so as to bind the latter into masses or clusters which lodge upon algæ, etc., and thus suspended receive more or less protection during their development. The ova of *F. heteroclitus* measure nearly a line in diameter, and develop in sea-water in about twenty-four days, at a temperature ranging from 55° to 63° Fahr.

The oil-drops are small and numerous, and are embedded in the vitellus, a little to one side of the blastodisk, and are gradually carried over the surface of the yolk as the blastoderm spreads. —*J. A. Ryder.*

OBSERVATIONS ON THE EMBRYOLOGY OF SPIDERS.—Some work done during the past winter on the embryology of several species of spiders at the biological laboratory of the Johns Hopkins University brought to light some facts of general interest.

The origin of the lung book of the spider is particularly interesting, in view of the comparisons instituted between Limulus and the arachnids. From good longitudinal sections of the spider embryo before the disappearance of the abdominal feet, it appears that the lung book may fairly be regarded as an involuted appendage or appendages. Before the involution of the abdominal appendages, the epithelium covering them assumes the characters of the epithelium of the lung book. At the same time the appendages become less conspicuous, and slight folds appear on their anterior faces.

By the complete involution of the abdominal appendages, and the increase in the number and distinctness of the folds on their anterior faces, a lung book would be formed with its laminæ directed backwards. All the stages of the process of involution were not observed, but probably in the species of spider upon which the most complete observations were made two pairs of abdominal feet are involuted.

Whether the conversion of the abdominal feet into the lung book is to be regarded as an involution of certain paired appendages, as was suggested by Lankester on theoretical grounds, or as a portion of the abdomen over which an appendage corresponding to the operculum of Limulus extends, could not be positively determined.

There appears, from one series of sections, to be a swelling corresponding in position to the operculum of Limulus just in advance of the involuted abdominal appendages.

Another point of interest in arachnid embryology is the presence of a fold in the blastoderm, surrounding the cephalic region of the embryo. Balfour described this fold as a groove. It appears, however, when studied by transverse and longitudinal sections to be a fold of the blastoderm. At the anterior extremity of the fold its opposite sides unite over the median line of the embryo, so that the brain is partially invested by an outer sheath or bag of epiblast formed by the united inner limbs of the opposite sides of the fold.

The origin of this fold and the union of its opposite sides over the middle line of the embryo correspond to the amnion of insects. The difference between the insect amnion and the spider amnion lies in the fact that in the former the union of the opposite sides of the amniotic fold is in most cases complete throughout the length of the embryo, while in the latter the folds are developed only in the head region of the embryo and coalesce at their anterior ends.—*A. T. Bruce, Ph.D.*